

**A COMPARISON OF THE CORROSION BEHAVIOUR OF
444 FERRITIC AND 316 AUSTENITIC STAINLESS STEELS
IN ACIDIC CHLORIDE MEDIA**

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A dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Masters of Science in Engineering.

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DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted to the University of the Witwatersrand, Johannesburg for the degree of Master of Science in Engineering. It has not been submitted before in any University for any degree or examination.

(Signature of candidate)

_____ Day of _____ 2009

ABSTRACT

The application and demand for 316 austenitic stainless steels in many industries including chemical, petroleum, process, marine, etc, and recently as architectural materials, together with the recent global economy crisis, present a strong challenge to engineers to search for a low cost alternative stainless steel with similar corrosion resistant properties to 316 austenitic stainless steel. As a result of the corrosion behavior of a comparatively low cost 444 ferritic stainless steel is compared in this study, with that of 316 austenitic stainless steel in acidic chloride environments where 316 are typically and mostly applied. The pitting corrosion resistances of the two alloys were studied by means of immersion tests and electrochemical techniques including cyclic potentiodynamic polarization, open circuit corrosion potential measurements and chronoamperometry. All the corrosion measurements were carried out at room temperature and at varying concentrations of the electrolytes. The alloys were also characterized prior and after corrosion tests using an optical microscope, scanning electron microscope, a Raman spectrometer and a X-ray diffractometer. The alloys displayed similar corrosion behaviour with slight differences in their corrosion resistance in all the solutions. The passivity of both alloys remained stable with no passivity breakdown and pitting in the lower concentrations of all the investigated solutions. It displayed poor passivation in 1 M hydrochloric acid. Alloy 316 was generally more resistance in all the solutions than alloy 444. Alloy 444 was better corrosion resistant in chloride environments than in the sulphuric acid, while alloy 316 was more resistant in sulphuric acid than in a chloride environment. This was corroborated by SEM analysis, and 444 had more corrosion pits in sulphuric acid while alloy 316 had more pits in chloride environments. XRD and Raman spectroscopy indicated that the corrosion products on alloy 444 in all the solutions were amorphous in nature, while those observed for alloy 316 were crystalline. It can be concluded that alloy 444 can be applied and successfully used to replace alloy 316 in chloride environments especially in sulphuric acid containing 3.5 % NaCl solution.

DEDICATION

This dissertation is dedicated to the almighty God for his immense love and grace upon my life and for taking me this far.

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